Title: Misleading or Not Misleading, Communicating Data Effectively

Brief Overview:

The purpose of this unit is to give the students an overview of the various ways that statistical information can be used and misused. Students will explore the implications of bias in data, decide which measures of central tendency would best represent a set of data, and determine why graphs may or may not be considered misleading.
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NCTM Content Standard/National Science Education Standard:

- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
- understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each;
- know the characteristics of well-designed studies, including the role of randomization in surveys and experiments;
- understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable;
- develop and evaluate inferences and predictions that are based on data
- use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions;
- understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference;
- evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions
- understand and apply basic concepts of probability
- understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases
- understand the concepts of conditional probability and independent events;

Grade/Level:

Grades 7 -12, Data Analysis

Duration/Length:

Three – 90 minute lessons

Student Outcomes:

Students will:

- Design and/or conduct an investigation that uses statistical methods to analyze data and communicate results
- Use simulations or statistical inferences from data to estimate the probability of an event
- Make informed decisions and predictions based upon the results of simulations and data from research
- Communicate the use and misuse of statistics

Materials and Resources:
- Large envelopes
- Scissors
- Materials for students to construct graphs
- Link to United Streaming (Introduction: Restaurant Data, Presentation, and Bias)
- Yes/No cards
- Graphing Calculators
- USA Today Snapshot (others can be obtained at http://www.usatoday.com/educate/statrat/)
- Newspapers/magazines for each student
- Worksheets
    Reviewing percents
    Survey Says
    Survey "Question" Worksheets
    Guided Notes "Samples"
    Biased or Unbiased, Representative, Simple Random Sample?
    Yes/No Cards
    More Practice with Samples
    Biased/Unbiased Extension Activity
    Representative and Simple Random Sample Worksheet
    Misleading Advertisement
    Representative Central Tendency
    Salary
    Reviewing Scatterplots
    Comparing Graphs
    Misleading Graphs – Guided Notes
    Newspaper Activity
    Summative Assessment
    Question Bank

Development/Procedures:

Lesson 1   Preassessment – Students will work through the problems from the overhead titled "Reviewing Percents" warm-up.

Launch – Number ten empty envelopes 1 – 10, and place them around the room. Have each student complete "Survey Says". Instruct students to separate each question and place them in the corresponding numbered envelope. This information will be used later in class.

Teacher Facilitation – If access to Discovery Education Streaming is available through your school district, then stream the video clip titled "Misrepresenting Data or Read all About It" (Follow the provided link in the resource section. After logging onto the website select Mathematics→ Grades 9 – 12 → Data Analysis → on the "Data Analysis" page search "Misleading Statistics". Select the clip "Misleading Data". There are 20 segments available, choose segment titled "Introduction: Restaurant Data, Presentation, and Bias). An alternative activity is to have a discussion about the word "Bias". Distribute the guided note sheet Guided Notes "Bias, Best Representative, and Simple Random Sample". Have the students "Think, Pair, Share". Give students 2 minutes to think about the word "Bias" and write down their thoughts. Give them an additional 2 - 3 minutes to share their thoughts with a person near them. Finally, take 4 – 5 minutes and have a class discussion. After the "Think, Pair, Share" begin an in-depth discussion on how biases can be recognized. "Can a sample be biased?" Follow this question with definitions of a simple random sample, best representative samples, and biased samples using the guided notes. Continue the discussion by asking "Can statistics be biased?" What are the pros and cons of bias?

Student Application – Once the class discussion and guided notes have been completed ask the students if the survey taken in class would be considered bias or unbiased. Break the students into small groups of two or three. Each group will take one of the question envelopes from the "Survey Says" activity and tabulate the results. They will take those results and make a bar graph, which they will be presenting to the class. In addition to the graph (students can decide which type of graph would best represent their data), each group will complete the "Survey" worksheet. Allow

students about twenty minutes to complete this activity. Each "question" group turn in a completed graph and worksheet. The graphs can be displayed around the room and used at a later time as a discussion tool.

Embedded Assessment – Give each student Yes/No cards. Review the definitions of bias versus unbiased data. Wrap –up the lesson by projecting "Bias or Unbiased", "Representative" and 'Simple Random Sample" on an overhead. Read each scenario and have students respond by raising a yes card for bias or no card unbiased.

Reteaching/Extension –
- For those who have not completely understood the lesson, assign the review worksheet "More Practice with Samples", where the students will identify scenarios as biased or unbiased.
- For those who have understood the lesson, assign "Biased/Unbiased Extension Activity", where the students will develop unbiased surveys. Have them share their surveys with each other.

Lesson 2   Preassessment – Students will complete a warm-up reviewing mean, median, and mode.

Launch – Give each student a Misleading Advertising worksheet. Allow the students twenty minutes to complete. Discuss as a class.

Teacher Facilitation – Explain that since data can be manipulated, it is important to look at all the measures of central tendency and makes decisions based on which one(s) best represents the data. Give each student a Representative Central Tendency packet. Allow the students forty-five minutes to complete.

Student Application – Give the students the Salary worksheet. Allow the students fifteen minutes to complete.

Embedded Assessment – Read and discuss students' responses to the last exercise from "Representative Central Tendency" and to the "Salary" worksheet.

Reteaching/Extension –
- For those who have not completely understood the lesson, a worksheet titled "More Practice with Persuasive Data" will be available.
- For those who have understood the lesson, have them create their own persuasive advertisement. Reference the "Sunshine's Brilliant Bistro" ad as an example of a persuasive advertisement. The ad must have data values showing that their advertisement can be supported honestly.

Lesson 3

Preassessment - Students will work through the problems from the overhead titled "Warm-up #3".

Launch - Place the USA Today Snapshot on the overhead. Have a class discussion about what the graph does and does tell the reader. Types of question the teacher can ask are: "What information is available from the graph" "Where did the data come from?" "Who were our presidents during the two decades identified with the best leadership?"

Teacher Facilitation - Begin a discussion on the usefulness of graphs. Transition into the new learning by asking, "Why would anyone want to present information in a misleading manner? Distribute the packet, "Misleading Graphs – Guided Notes". Display "Comparing Graphs" and have students compare Graph A and Graph B. Ask, "What is the same about both graphs? What is different? Does each graph have its own message? Have the students completed the guided notes during the discussion. Show the graphs of Charly ask the question; If Charly wants Chloe to believe he makes more money than her, which graph should he use? Why?

Student Application- Prior to the lesson collect several different newspaper over several different days, such as USA Today. (USA Today is a good newspaper to use because there are always numerous graphs in every issue.) Distribute the worksheet, "Newspaper Activity", and give each student a newspaper. Have the student look through the paper and cut out three graphs. Have them complete the activity by pasting the graphs onto the worksheet and answering the questions.

Embedded Assessment – While the students are working on the newspaper assignment, walk through the room and monitor

students' progress. Reading their responses to the questions will help determine how much the students have grasped the concept of misleading graphs.

Reteaching/Extension –
- Collect the guided notes. Make comments that will be instructive in nature on the notes.
- As an opener for the next class review the notes with the class as a whole. This would be an excellent time to have those students who had good responses to share, thus giving them an opportunity to reteach felloww students.

Summative Assessment:

A summative assessment is at the end of the packet. The questions are in the form of Student Produced Responses (SPRs or multiple choice) and Constructed Response (CRs) questions. The CRs are not in BCR or ECR format, but could easily be adapted. These types of questions correlate to the Maryland HSA.

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Warm – Up #1

Evaluate the following:

1) 60 % of 200

2) What is 32 % of 75?

3) 18 if 12% of what number?

Warm – Up #1   **Answer Key**

Evaluate the following:

1) 60 % of 200

 0.60 x 200 = 120

2) What is 32 % of 75?

 0.32 x 75 = 24

3) 18 if 12% of what number?

 18 / .12 = 150

Survey says …

Complete each of the following survey questions. Cut out the questions and place each question in the corresponding numbered envelope.

1) What is your favorite style of music?
    a. Rock
    b. Hip-Hop
    c. Rap
    d. Punk
    e. Other

2) What is your favorite type of food?
    a. Chinese
    b. Mexican
    c. Italian
    d. American (burgers, hotdogs, steaks, etc.)
    e. Other

3) What is your favorite flavor of ice cream?
    a. Chocolate
    b. Vanilla
    c. Strawberry
    d. Cookies and Cream
    e. Other

4) What is your favorite color? (The color can be shades of the following)
    a. Blue
    b. Green
    c. Red
    d. Purple
    e. Other

5) What is your favorite type of movie?
    a. Drama
    b. Comedy
    c. Mystery
    d. Horror
    e. Other

6) What is your favorite type of sandwich?
    a. Hamburger/Cheeseburger
    b. Chicken
    c. Ham
    d. Turkey
    e. Other

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7) What is your favorite gaming system?
    a. Xbox
    b. PS3
    c. Wii
    d. Nintendo 64
    e. Other

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8) What is your favorite soda?
    a. Coca-Cola
    b. Pepsi
    c. Dr. Pepper
    d. Mountain Dew
    e. Other

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9) What is your favorite store?
    a. Hollister
    b. Aeropostale
    c. American Eagle
    d. Abercrombie and Fitch
    e. Other

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10) What is your favorite past time?
    a. Reading
    b. Listening to music
    c. Watching TV
    d. Sports
    e. Other

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

    A. What is the probability that a student in the class prefers rock?

    B. What is the probability that a student in the class prefers hip-hop?

    C. What is the probability that a student in the class prefers rap?

    D. What is the probability that a student in the class prefers punk?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer rock music.

Question 2   Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your
   question from the survey.

3. Calculate the probabilities below as a percentage:

   A. What is the probability that a student in the class prefers Chinese food?

   B. What is the probability that a student in the class prefers Mexican food?

   C. What is the probability that a student in the class prefers Italian food?

   D. What is the probability that a student in the class prefers American food?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer Chinese food.

Question 3   Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage: What is your favorite flavor of ice cream?
    a.

   A. What is the probability that a student in the class prefers chocolate ice cream?

   B. What is the probability that a student in the class prefers vanilla ice cream?

   C. What is the probability that a student in the class prefers strawberry ice cream?

   D. What is the probability that a student in the class prefers cookies and cream ice cream?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer chocolate ice cream.

Question 4   Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your
   question from the survey.

3. Calculate the probabilities below as a percentage:

   A. What is the probability that a student in the class prefers blue?

   B. What is the probability that a student in the class prefers green?

   C. What is the probability that a student in the class prefers red?

   D. What is the probability that a student in the class prefers purple?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer the color blue.

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

   A. What is the probability that a student in the class prefers a drama?

   B. What is the probability that a student in the class prefers a comedy?

   C. What is the probability that a student in the class prefers a mystery?

   D. What is the probability that a student in the class prefers horror films?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer comedies.

Question 6   Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

   A. What is the probability that a student in the class prefers hamburgers/cheeseburgers?

   B. What is the probability that a student in the class prefers chicken?

   C. What is the probability that a student in the class prefers ham?

   D. What is the probability that a student in the class prefers turkey?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer turkey.

Question 7   Name: _____

   1. The total number of students who took the survey is: _____

   2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

   3. Calculate the probabilities below as a percentage:

     A. What is the probability that a student in the class prefers an Xbox?

     B. What is the probability that a student in the class prefers a PS3?

     C. What is the probability that a student in the class prefers a Wii?

     D. What is the probability that a student in the class prefers a Nintendo 64?

   4. The total number of students in our school is: _____

   5. Predict how many people in the entire school prefer an Xbox.

Question 8   Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

    A. What is the probability that a student in the class prefers Coca-Cola?

    B. What is the probability that a student in the class prefers Pepsi?

    C. What is the probability that a student in the class prefers Dr. Pepper?

    D. What is the probability that a student in the class prefers Mountain Dew?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer Coca-Cola.

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

    A. What is the probability that a student in the class prefers Hollister?

    B. What is the probability that a student in the class prefers Aeropostale?

    C. What is the probability that a student in the class prefers American Eagle?

    D. What is the probability that a student in the class prefers Abercrombie and Fitch?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer Hollister.

Name: _____

1. The total number of students who took the survey is: _____

2. On a separate sheet of paper, create a bar graph displaying the results of your question from the survey.

3. Calculate the probabilities below as a percentage:

   A. What is the probability that a student in the class prefers reading?

   B. What is the probability that a student in the class prefers listening to music?

   C. What is the probability that a student in the class prefers watching TV?

   D. What is the probability that a student in the class prefers sports?

4. The total number of students in our school is: _____

5. Predict how many people in the entire school prefer reading.

Samples: Guided Notes   Name: _____

Objective: Students will be able to identify various sampling techniques and recognize biased samples.

- Define the term "bias" in your own words.

- Share your definition with a partner. Write down any similarities.

Lesson:

Word	Definition	Example
Sample		
Population		
Census		
Random Sample • Simple Random Sample		
Biased Samples		
Best Representative Sample		

Samples: Guided Notes   Name: _Answer Key_____

Objective: Students will be able to identify various sampling techniques and recognize biased samples.

- Define the term "bias" in your own words.

- Share your definition with a partner. Write down any similarities.

Lesson:

Word	Definition	Example
Sample	A portion of a larger group	8th graders in a middle school
Population	Entire group	6th, 7th, and 8th graders of a middle school.
Census	All units of a population are included.	See above
Random Sample • Simple Random Sample	A representative sample of a population • All parts of the population have an equal likely chance of being chosen.	• A student's name is selected at random by placing all the names in a hat.
Biased Samples	Favor occurs in some way for some part of the population	• 10 apples selected from the top bin only to check for spoilage • Responses from radio show call-in surveys.
Best Representative Sample	A simple random sample with little or no bias.	• The Board of Education randomly selecting students from every school in the county to participate in survey on education satisfaction.

YES

NO

Biased (Yes) or Unbiased (No)?

1) Eight citizens are asked their opinions about what trash should be collected.

2) A phone-in survey is taken by a radio station to see how many listeners enjoy jazz in the morning.

3) Every fortieth student who enters the school is asked to name their favorite sport.

4) Ten students are randomly selected to participate in a survey about home computer usage.

5) Each math class randomly selects two students do represent their class on an advisory panel being assembled by the principal.

6) A shirt manufacturer wants to check quality control of their products. The plant manager decides to check every 5th shirt inspected by Inspector D. There are 15 inspectors in the plant.

7) A survey is conducted at the local shopping mall about household products used on a daily basis.

Biased (Yes) or Unbiased (No)?   **Answer Key**

1) Eight citizens are asked their opinions about what trash should be collected.

   Yes, Biased, sample size too small

2) A phone-in survey is taken by a radio station to see how many listeners enjoy jazz in the morning.

   Yes, Biased, response are only from listeners who decide to call in

3) Every fortieth student who enters the school is asked to name their favorite sport.

   No, Unbiased, systematic

4) Ten students are randomly selected to participate in a survey about home computer usage.

   No, Unbiased, random

5) Each math class randomly selects two students do represent their class on an advisory panel being assembled by the principal.

   No, Unbiased, random

6) A shirt manufacturer wants to check quality control of their products. The plant manager decides to check every 5th shirt inspected by Inspector D. There are 15 inspectors in the plant.

   Yes, Biased, only Inspector D's shirts are being checked

7) A survey is conducted at the local shopping mall about household products used on a daily basis.

   Yes, Biased, only customers at the shopping mall have an opportunity to be surveyed

Representative Sample Scenarios

Are these samples representative?

1. To determine the percentage of teenage girls with long hair, *Teen* magazine published a mail-in questionnaire. Of the 500 respondents, 85% had hair shoulder length or longer (*USA Today*, July 1, 1985).

2. A college psychology professor needs subjects for a research project to determine which colors average American adults find restful. From the list of all 743 students taking introductory psychology at her school, she selects 25 students using a random number table.

3. To evaluate the reliability of cars owned by its subscribers, *Consumer Reports* magazine publishes a yearly list of automobiles and their frequency-of-repair records. The magazine collects the information by mailing a questionnaire to subscribers and tabulating the results from those who return it.

4. Oranges from an orchard need to be samples to see if they are sweet enough for juice. The orchard has 25,000 orange trees. Each tree has at least 500 oranges. Claire decides to randomly choose 800 trees and test one orange from each tree.

5. For a survey of student opinions about school athletic programs, a member of the school board obtains a sample of students by listing all students in the school and using a random number table to select 30 of them. Six of the students say that they don't have time to participate, and they are eliminated from the sample.

6. There are fifteen boys and fifteen girls in a math class. Each student's name is placed in a hat and the names are thoroughly mixed. Seven names are drawn and all names correspond to the boys in the class.

Representative Sample Scenarios   **Answer Key**

1. To determine the percentage of teenage girls with long hair, *Teen* magazine published a mail-in questionnaire. Of the 500 respondents, 85% had hair shoulder length or longer (*USA Today*, July 1, 1985).

   No (only teenagers who read *Teen* and choose to write would represent al teens)

2. A college psychology professor needs subjects for a research project to determine which colors average American adults find restful. From the list of all 743 students taking introductory psychology at her school, she selects 25 students using a random number table.

   No (only includes students which would not include many "average American adults"; students are often young so many ages would not be represented)

3. To evaluate the reliability of cars owned by its subscribers, *Consumer Reports* magazine publishes a yearly list of automobiles and their frequency-of-repair records. The magazine collects the information by mailing a questionnaire to subscribers and tabulating the results from those who return it.

   No (men would probably be better represented than women; only people who read *Consumer Reports* and choose to respond would be represented)

4. Oranges from an orchard need to be samples to see if they are sweet enough for juice. The orchard has 25,000 orange trees. Each tree has at least 500 oranges. Claire decides to randomly choose 800 trees and test one orange from each tree.

   yes

5. For a survey of student opinions about school athletic programs, a member of the school board obtains a sample of students by listing all students in the school and using a random number table to select 30 of them. Six of the students say that they don't have time to participate, and they are eliminated from the sample.

   No (1/6 of the chosen sample was eliminated which is not representative to the entire school)

6. There are fifteen boys and fifteen girls in a math class. Each student's name is placed in a hat and the names are thoroughly mixed. Seven names are drawn and all names correspond to the boys in the class.

   No (only boys are represented)

Simple random sample:
1. Each member of the population is equally likely to be chosen and
2. The members of the sample are chosen independently of one another

Does this sampling method produce a simple random sample from a class of 30 students?

1. A teacher selects the first five students that enter the room.

2. A teacher wants to select ten students from the class. She lists students in alphabetical order, then selects every third student.

3. A teacher wants to select five students from the class. Suppose that the classroom has six rows of chairs with five chairs in each row. The teacher assigns the rows the digits 1 through 6. She throws a die and selects all the students in the row corresponding to the number on the die in the sample.

4. Assign each student a number from 1 to 30. The girls get the numbers 1 to 15 and the boys the numbers from 16 to 30. Use a random number table to select six two-digit numbers between 1 and 30, and select the corresponding students in the sample.

5. There are fifteen boys and fifteen girls in a math class. Each student's name is placed in a hat and the names are thoroughly mixed. Seven names are drawn and all names correspond to the boys in the class.

Simple Random Sample   **Answer Key**

1. A teacher selects the first five students that enter the room.

   No (each student does not have an equally likely chance of being chosen)

2. A teacher wants to select ten students from the class. She lists students in alphabetical order, then selects every third student.

   No (every student does not have a chance to be chosen)

3. A teacher wants to select five students from the class. Suppose that the classroom has six rows of chairs with five chairs in each row. The teacher assigns the rows the digits 1 through 6. She throws a die and selects all the students in the row corresponding to the number on the die in the sample.

   No (each student does not have an equally likely chance to be chosen and the students picked on dependent on each other)

4. Assign each student a number from 1 to 30. The girls get the numbers 1 to 15 and the boys the numbers from 16 to 30. Use a random number table to select six two-digit numbers between 1 and 30, and select the corresponding students in the sample.

   yes

5. There are fifteen boys and fifteen girls in a math class. Each student's name is placed in a hat and the names are thoroughly mixed. Seven names are drawn and all names correspond to the boys in the class.

   yes

More Practice with Samples   Name: _____

I. Read each scenario and determine if each sample is biased or unbiased. If the sample is biased, explain why it is biased.

1)   A company is interested in opening a gym on its premises for all employees. They ask all 3rd shift workers (11 pm – 7 am) if they would use the gym, and what hours they would like the gym to be open.

2)   Republicans send out a survey to 500 registered republicans in 3 states to determine the issues that should be focused on for the next election..

3) Each week a teacher randomly selects one student from each class to review homework answers with the rest of the class.

II. Read each scenario and determine if each sample is a representative sample. If the sample is not representative, explain why it is not representative.

4) To obtain a sample of households, a television rating service dials numbers taken at random from telephone directories.

5) In 1984, Ann Landers conducted a poll on the marital happiness of women by asking women to write to her.

6) A clothing company wants to know what color leggings teenagers will buy. The company decides to spend one day in the junior departments of five randomly selected stores in randomly selected cities and ask every teenager who enters what color leggings they buy.

III. Read each scenario and determine if each sample is a simple random sample. If the sample is not a simple random sample, explain why it is not a simple random sample.

7) A teacher selects those students whose phone numbers end with the digit 4.

8) There are fifteen boys and fifteen girls in a history class. A teacher selects a sample of six students by using a random number table to choose 1 of the 15 boys, then 1 of the 15 girls, then a boy, then a girl, and so on until she has chosen 6 students.

9) A teacher wants to select six students from the class. She writes each student's name on an index card, places the index cards in a box, mixes the cards, then chooses six cards from the box.

More Practice with Samples   Name: _Answer Key_____

I. Read each scenario and determine if each sample is biased or unbiased. If the sample is biased, explain why it is biased.

1)   A company is interested in opening a gym on its premises for all employees. They ask all 3rd shift workers (11 pm – 7 am) if they would use the gym, and what hours they would like the gym to be open.

   Biased, convenient, not all workers have a chance to give their input.

2)   Republicans send out a survey to 500 registered republicans in 3 states to determine the issues that should be focused on for the next election.

   Biased, voluntary. There is not a sample from every state.

3)   Each week a teacher randomly selects one student from each class to review homework answers with the rest of the class.

   Unbiased, simple random sample.

II. Read each scenario and determine if each sample is a representative sample. If the sample is not representative, explain why it is not representative.

4)   To obtain a sample of households, a television rating service dials numbers taken at random from telephone directories.

   No (some households may have unlisted telephone numbers)

5)   In 1984, Ann Landers conducted a poll on the marital happiness of women by asking women to write to her.

   No (only women who read Ann Landers and choose to write would represent all women)

6)   A clothing company wants to know what color leggings teenagers will buy. The company decides to spend one day in the junior departments of five randomly selected stores in randomly selected cities and ask every teenager who enters what color leggings they buy.

   Yes

III. Read each scenario and determine if each sample is a simple random sample. If the sample is not a simple random sample, explain why it is not a simple random sample.

7) A teacher selects those students whose phone numbers end with the digit 4.

   No (every student doe not have a chance to be chosen)

8) There are fifteen boys and fifteen girls in a history class. A teacher selects a sample of six students by using a random number table to choose 1 of the 15 boys, then 1 of the 15 girls, then a boy, then a girl, and so on until she has chosen 6 students.

   No (one event depends on the previous event)

9) A teacher wants to select six students from the class. She writes each student's name on an index card, places the index cards in a box, mixes the cards, then chooses six cards from the box.

   Yes

Biased/Unbiased Extension Activity   **Name:** _____

For each scenario below:
- Determine the sample and population you would need to survey to obtain a representative sample.
- Determine how you would survey the population to obtain a simple random sample.
- Design two survey questions which are free of bias.

1) Suppose you want to know if a manufacturing plant is discharging contaminants into the Chesapeake Bay.

2) Suppose you want to know the issues most important to teachers at your school.

Warm-Up #2

1. Find the mean, median, and mode for the data set

    5, 12, 7, 14, 8, 9, 5

2. A survey of 20 students was conducted to find out how many books they had read during the past four months. The results from those 20 students are shown below. Find the mean, median and mode for this data.

    3, 4, 6, 1, 2, 2, 5, 6, 1, 3, 4, 3, 5, 11, 12, 10, 2, 9, 6, 7

3. Movies R Us keeps a record of how many movies are rented on each day of the week.

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
420	260	220	430	700	660	410

Find the mean, median, and mode for this data (rounded to the nearest whole number).

1. Find the mean, median, and mode for the data set

    5, 12, 7, 14, 8, 9, 5

    Mean = 8.6, Median = 8, Mode = 5

2. A survey of 20 students was conducted to find out how
   many books they had read during the past four months.
   The results from those 20 students are shown below.
   Find the mean, median and mode for this data.

    3, 4, 6, 1, 2, 2, 5, 6, 1, 3, 4, 3, 5, 11, 12, 10, 2, 9, 6, 7

    Mean = 5.1, Median = 4.5, Mode = 2, 3, 6
    (none because more than 2 values)

3. Movies R Us keeps a record of how many movies are
   rented on each day of the week.

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
420	260	220	430	700	660	410

Find the mean, median, and mode for this data (rounded to the nearest whole number).

    Mean = 443, Median = 420**, Mode = non**e

Misleading Advertising   Name: _____

Advertisers, who want you to buy their products, present information about their products in ways that make their product more appealing than it might actually be. They are very persuasive with their facts, manipulating data reports to their advantage. They use the measures of central tendency that best represent their product, rather than the one that may more accurately represent their product.

Nutrition is currently an important trend. Eating right makes you feel good, and it reduces your risk for some diseases. Americans are trying to eat healthier. To eat healthier, we avoid fats, added sugars, and salt. We also try to limit the number of calories we consume.

Sunshine's Brilliant Bistro is opening in one week. The owner, Mr. Sunshine, wants to advertise so that he has a successful opening week. Mr. Sunshine thinks his restaurant will be successful if he advertises that his food is healthy and low in cost.

The table below displays the calories, fat, and cost of the entrees.

Entrees	Calories	Total Fat (g)	Cost
Hamburger	375	10	$7.95
Cheeseburger	475	14	$8.95
Grilled Chicken Sandwich	450	13	$8.95
Asian Salad with Vinegrette Dressing	130	6	$8.00
Caesar Salad with Grilled Chicken	380	24	$8.95
Vegetarian Delight	300	3	$6.50
Meatball Marinara Sub	610	28	$6.95
Grilled Tuna Sandwich	450	10	$12.95

1. Calculate the mean, median, and mode of the calories and total fat for the entrees.

	Calories	**Total Fat (g)**
Mean	_____	_____
Median	_____	_____
Mode	_____	_____

2. Based on calories, which measure of central tendency should Mr. Sunshine use to demonstrate that his restaurant is a healthy choice? Justify your answer.

_____

_____

_____

3. Based on total fat, which measure of central tendency should Mr. Sunshine use to demonstrate that his restaurant is a healthy choice? Justify your answer.

_____

_____

_____

Mr. Sunshine's advertising group created the ad below to demonstrate that the restaurant is low in cost.

Sunshine's Brilliant Bistro

GRAND OPENING: June 21

A healthful bistro at a reasonable cost.
Eat for a bargain.
Entrees average less than $8.50 per person!

4. Is this ad correct?

5. Which measure of central tendency allows the advertising group to honestly use this ad? Justify your answer.

_____

_____

_____

Misleading Advertising   Name: _**Answer Key**_____

Advertisers, who want you to buy their products, present information about their products in ways that make their product more appealing than it might actually be. They are very persuasive with their facts, manipulating data reports to their advantage. They use the measures of central tendency that best represent their product, rather than the one that may more accurately represent their product.

Nutrition is currently an important trend. Eating right makes you feel good, and it reduces your risk for some diseases. Americans are trying to eat healthier. To eat healthier, we avoid fats, added sugars, and salt. We also try to limit the number of calories we consume.

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Caesar Salad with Grilled Chicken	380	24	$8.95
Vegetarian Delight	300	3	$6.50
Meatball Marinara Sub	610	28	$6.95
Grilled Tuna Sandwich	450	10	$12.95

1. Calculate the mean, median, and mode of the calories and total fat for the entrees.

              Calories   Total Fat (g)

Mean   ___**396.25**___   ___**13.5**___

Median   ____**415**___   ____**11.5**____

Mode   ____**450**___   _____**10**_____

2. Based on calories, which measure of central tendency should Mr. Sunshine use to demonstrate that his restaurant is a healthy choice? Justify your answer.

Mr. Sunshine should use the mean to demonstrate that his restaurant is a healthy choice because the mean is the smallest average. A healthy restaurant should serve food that is low in calories.

3. Based on total fat, which measure of central tendency should Mr. Sunshine use to demonstrate that his restaurant is a healthy choice? Justify your answer.

Mr. Sunshine should use the mode to demonstrate that his restaurant is a healthy choice because the mode is the smallest average. A healthy restaurant should serve food that is low in fat.

Mr. Sunshine's advertising group created the ad below to demonstrate that the restaurant is low in cost.

Sunshine's Brilliant Bistro

GRAND OPENING: June 21

A healthful bistro at a reasonable cost.
Eat for a bargain.
Entrees average less than $8.50 per person!

---

4. Is this ad correct? Mean = 8.65, mode = 8.95, median = 8.48

yes

5. Which measure of central tendency allows the advertising group to honestly use this ad? Justify your answer.

The advertising group is using the median is an average for the ad. The median is $8.48, which is less than $8.50. (The mean is $8.65 and the mode is $8.95).

Representative Central Tendency   Name: _____

Mr. Sunshine sent his restaurant manager, Clark Cloudy, to poll people about food costs. Clark visited various cities and multiple restaurants in each city. He asked every 10th customer: "What do you think is a reasonable price for a tasty and healthy meal?" The results from Clark's inquiry are below:

$9.50	$6.50	$6.50	$7.00	$5.50
$5.50	$6.50	$7.50	$4.50	$5.00
$7.00	$6.00	$7.00	$20.00	$9.00
$8.50	$6.00	$6.00	$7.50	$7.50
$7.00	$9.50	$8.00	$6.50	$8.00

1. Find the mean, median, and mode of the prices.

2. Create a frequency table from the data above.

3. Look at your frequency table. The sum of which column determines the total
    number of data values?

4. What is the total number of data values?

5. Calculate the mean without using the lists on your calculator.
    a) Calculate the sum of all the data values:

    b) Divide the sum by the total number of data values. This will be the mean.

    c) Compare your answer with the mean you calculated in problem #1. Did
        you get the same answer?

6. Find the median without using the lists on your calculator.
    a) To find the placement of the median (the "middle" number) take the
        total number of data values and divide by two.

    b) The median is located in place _____.

    c) Find the data value located in the middle spot. This is your median.

    d) Compare your answer with the median you calculated in problem #1. Did
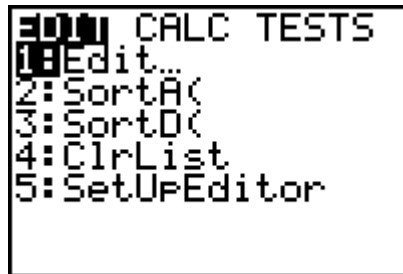   you get the same answer?

Now let's calculate the mean and median using the list function on your graphing calculator.

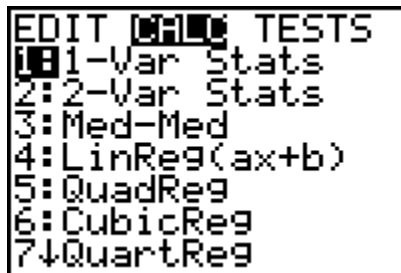**Step 1: Enter the data in the lists**

Enter your frequency table into the lists in your calculator. Enter the food prices in L1 and the frequencies in L2.

To access this list press **STAT** and choose **EDIT** and then press **ENTER**.
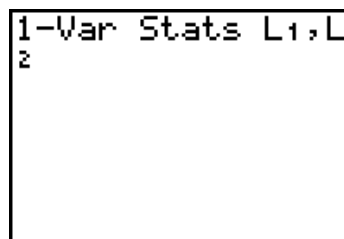
```
EDIT CALC TESTS        L1    L2    L3    1
1◼Edit…
2:SortA(               ◼─── ───── ──────
3:SortD(
4:ClrList
5:SetUpEditor


L1(1)=
```

Step 2: Calculate the Statistics (Mean and Median) of a List:

Press the **STAT** key and use the blue arrow to move to **CALC**. Select **1-Var Stats** and press **ENTER.**

```
EDIT CALC TESTS        1-Var Stats
1◼1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
```

The calculator is now waiting for you to tell it which list to calculate. You must use both lists on a frequency table because the lists correspond with each other.

Press **2nd** **1** to choose L1, press **,** , and finally press **2nd** **2** to choose L2. Press **ENTER**.

```
1-Var Stats L₁,L
₂
```

Use the blue arrow keys to scroll down to see all of the statistics. (NOTE: These are not the correct data values.)

```
1-Var Stats
 x̄=18.08333333
 Σx=217
 Σx²=8245
 Sx=19.8194502
 σx=18.97567888
↓n=12
```

```
1-Var Stats
↑n=12
 minX=5
 Q1=6.5
 Med=9
 Q3=23.5
 maxX=65
```

x̄	Mean Average of Set
Σx	Sum of the Elements of the Set
n	Total Number of Elements in the Set
minX	Minimum Value
Q₁	Lower Quartile
Med	Median
Q₃	Upper Quartile
MaxX	Maximum Value
Sx	Sample Standard Deviation of x
σx	Population Standard Deviation of x

Record the mean and median you just calculated using the lists on your graphing calculator.

Mean _____

Median _____

Compare your mean with the mean you calculated in problem #1 and #5 by hand. Did you get the same answer?

Compare your median with the median you calculated in problem #1 and problem #6 by hand. Did you get the same answer?

Which measure of central tendency best represents a reasonable price for a meal? Justify your answer.

_____

_____

Representative Central Tendency   Name: ____**Answer Key**_____

Mr. Sunshine sent his restaurant manager, Clark Cloudy, to poll people about food costs. Clark visited various cities and multiple restaurants in each city. He asked every 10th customer: "What do you think is a reasonable price for a tasty and healthy meal?" The results from Clark's inquiry are below:

$9.50	$6.50	$6.50	$7.00	$5.50
$5.50	$6.50	$7.50	$4.50	$5.00
$7.00	$6.00	$7.00	$20.00	$9.00
$8.50	$6.00	$6.00	$7.50	$7.50
$7.00	$9.50	$8.00	$6.50	$8.00

1. Find the mean, median, and mode of the prices.

   Mean = 7.50

   Median = 7.00

   Mode = 6.50, 7.00

2. Create a frequency table from the data above.

Price	Frequency
4.50	1
5.00	1
5.50	2
6.00	3
6.50	4
7.00	4
7.50	3
8.00	2
8.50	1
9.00	1
9.50	2
20.00	1

3. Look at your frequency table. The sum of which column determines the total number of data values?

frequency

4. What is the total number of data values?

25

5. Calculate the mean without using the lists on your calculator.
   a) Calculate the sum of all the data values:

   $4.50 \cdot 1 + 5.00 \cdot 1 + 5.50 \cdot 2 + 6.00 \cdot 3 +$

   $6.50 \cdot 4 + 7.00 \cdot 4 + 7.50 \cdot 3 + 8.00 \cdot 2 +$

   $8.50 \cdot 1 + 9.00 \cdot 1 + 9.50 \cdot 2 + 20.00 \cdot 1 = 187.5$

   b) Divide the sum by the total number of data values. This will be the mean.

   $187.5 \div 25 = 7.50$

   c) Compare your answer with the mean you calculated in problem #1. Did you get the same answer?

   yes

6. Find the median without using the lists on your calculator.
   a) To find the placement of the median (the "middle" number) take the total number of data values and divide by 2.

   $25 \div 2 = 12$

   b) The median is located in place **13**.

   c) Find the data value located in the middle spot. This is your median.

   7.00.

   d) Compare your answer with the median you calculated in problem #1. Did you get the same answer? **yes**
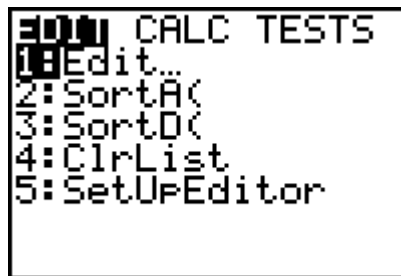
Now let's calculate the mean and median using the list function on your graphing calculator.

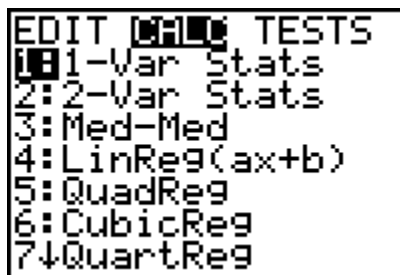**Step 1: Enter the data in the lists**

Enter your frequency table into the lists in your calculator. Enter the food prices in L1 and the frequencies in L2.

To access this list press **STAT** and choose **EDIT** and then press **ENTER**.

```
EDIT CALC TESTS
1▮Edit…
2:SortA(
3:SortD(
4:ClrList
5:SetUpEditor
```

```
L1      L2      L3      1
▬▬▬▬    ------  ------
        ------  ------



L1(1)=
```

Step 2: Calculate the Statistics (Mean and Median) of a List:

Press the **STAT** key and use the blue arrow to move to **CALC**. Select **1-Var Stats** and press **ENTER**.

```
EDIT CALC TESTS
1▮1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7↓QuartReg
```

```
1-Var Stats
```

The calculator is now waiting for you to tell it which list to calculate. You must use both lists on a frequency table because the lists correspond with each other.

Press **2nd** **1** to choose L1, press **,** , and finally press **2nd** **2** to choose L2. Press

ENTER.

```
1-Var Stats L₁,L
₂
```

Use the blue arrow keys to scroll down to see all of the statistics. (NOTE: These are not the correct data values)

```
1-Var Stats          1-Var Stats
 x̄=18.08333333       ↑n=12
 Σx=217               minX=5
 Σx²=8245             Q₁=6.5
 Sx=19.8194502        Med=9
 σx=18.97567888       Q₃=23.5
↓n=12                 maxX=65
```

x̄	Mean Average of Set
Σx	Sum of the Elements of the Set
n	Total Number of Elements in the Set
minX	Minimum Value
Q₁	Lower Quartile
Med	Median
Q₃	Upper Quartile
MaxX	Maximum Value
Sx	Sample Standard Deviation of x
σx	Population Standard Deviation of x

Record the mean and median you just calculated using the lists on your graphing calculator.

Mean **7.50**

Median **7.00**

Compare your mean with the mean you calculated in problem #1 and #5 by hand. Did you get the same answer?

yes

Compare your median with the median you calculated in problem #1 and problem #6 by hand. Did you get the same answer?

yes

Which measure of central tendency best represents a reasonable price for a meal? Justify your answer.

The mode or the median because they are less than the mean.

Salaries Worksheet   Name _____

A company has 80 employees. The frequency table below shows their salaries.

EMPLOYEE SALARIES

Salary	Frequency
$16,500	40
$22,300	16
$30,100	9
$34,800	7
$42,500	5
$51,100	2
$130,300	1

- Use the frequency table to find the mean and median salaries.

- As an employee, would you use the mean or median to ask for raises for the employees with lower salaries? Use mathematics to justify your answer.

Salaries Worksheet   Name _____**Answer Key**_____

A company has 80 employees. The frequency table below shows their salaries.

EMPLOYEE SALARIES

Salary	Frequency
$16,500	40
$22,300	16
$30,100	9
$34,800	7
$42,500	5
$51,100	2
$130,300	1

- Use the frequency table to find the mean and median salaries.

    Mean = 24703.75

    Median = 19400

- As an employee, would you use the mean or median to ask for raises for the employees with lower salaries? Use mathematics to justify your answer.

    As an employee, I would use the median to ask for raises for the employees because it shows that the average salary is low. The median is less than the mean which would help convince an employer that the employees need a raise.

More Practice with Persuasive Data   Name _____

I. Define:

1. Mean –

   _____

   _____

2. Median –

   _____

   _____

3. Mode –

   _____

   _____

II. Steve received the following 11 quiz scores during the 2nd quarter.

   Quiz Scores: 86, 91, 84, 73, 83, 23, 93, 91, 82, 83, 81

4. What are the mean, median, and mode of Steve's scores?

   _____

   _____

   _____

5. What is the minimum score and the maximum score?

   _____

6. What grade did Steve earn using the mean? (A-90's, B-80's, C-70's, etc)

    _____

7. What grade did Steve earn using the median?

    _____

8. What grade should Steve receive on his report card? Use mathematics to justify your answer.

    _____

    _____

More Practice with Persuasive Data　　　Name _____**Answer Key**_____

I. Define:

1. Mean – **an average used to describe a data set; it is found by adding all the data values and dividing by the number of data values**

2. Median – **an average used to describe a data set; it is the middle value in an ordered set of data values**

3. Mode – **an average used to describe a data set; it is the value that occurs the most in a set of data values**

II. Steve received the following 11 quiz scores during the 2nd quarter.

　　　Quiz Scores: 86, 91, 84, 73, 83, 23, 93, 91, 82, 83, 81

4. What are the mean, median, and mode of Steve's scores?

　　Mean = 79.1

　　Median = 83

　　Mode = 83, 91

5. What is the minimum score and the maximum score?

　　Minimum score = 23, Maximum score = 93

6. What grade did Steve earn using the mean? (A-90's, B-80's, C-70's, etc)

    C (79)

7. What grade did Steve earn using the median?

    B (83)

8. What grade should Steve receive on his report card? Use mathematics to justify your answer.

    Answers may vary. Check justification.

Warm-Up #3

The table below shows the percent of U.S. workers in Farm occupations.

Years since 1900	0	20	40	60	80	94
Farm Workers	37.5	27	17.4	6.1	2.7	2.5

1) Construct a scatter plot of the data

2) Determine the correlation, if any, between the number of farm workers and the years since 1900.

3) Draw a line of best fit, and find the equation of the line in slope – intercept form.

The table below shows the percent of U.S. workers in Farm occupations.

Years since 1900	0	20	40	60	80	94
Farm Workers	37.5	27	17.4	6.1	2.7	2.5

1) and 3) Construct a scatter plot of the data. **(Line of best fit and equation are on the graph)**
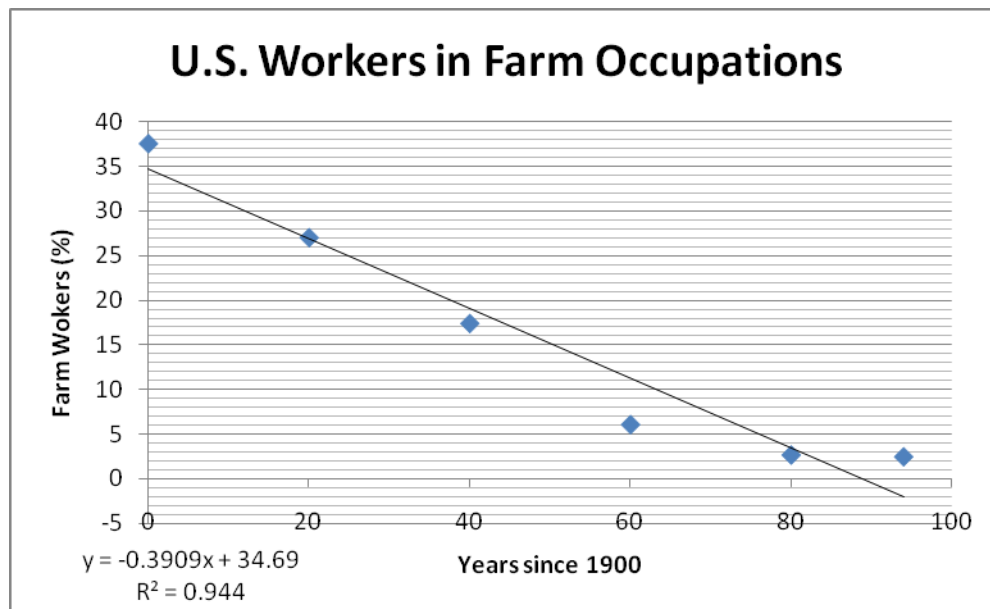
U.S. Workers in Farm Occupations

$y = -0.3909x + 34.69$
$R^2 = 0.944$

Years since 1900

2) Determine the correlation, if any, between the number of farm workers and the years since 1900. **There is a negative correlation. As the years increase the number of farm workers decrease.**

USA Today Snapshot

USA SNAPSHOTS®

A look at statistics that shape the nation

A time of leadership

The decade people think the USA had its best leadership:

Decade	Percentage
1930s or before	6.3%
1940s	14.3%
1950s	17.2%
1960s	23.6%
1970s	7.9%
1980s	22.4%
1990s	8.4%
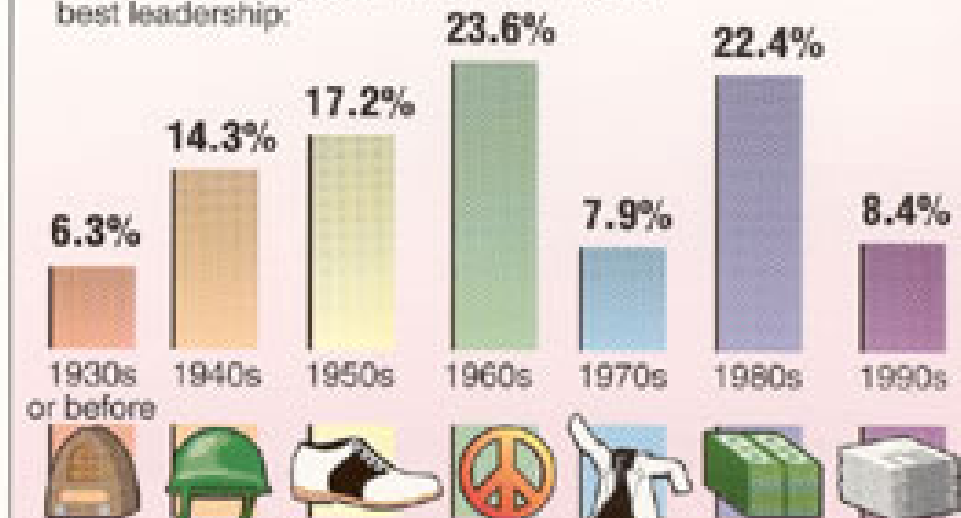
Source: Bruskin Goldring Research survey for Tompkins Associates

By Cindy Hall and Nick Galifianakis, USA TODAY

Name:_____

Guided Notes – "Misleading Graphs"

Objective: Communicate the use and misuse of statistics

- Why do people use graphs to display data?

- What are some of the reasons/ways a graph can be misleading?

Look at graphs A and B about Charley and Chloe's babysitting earnings

Graph A   **Graph B**
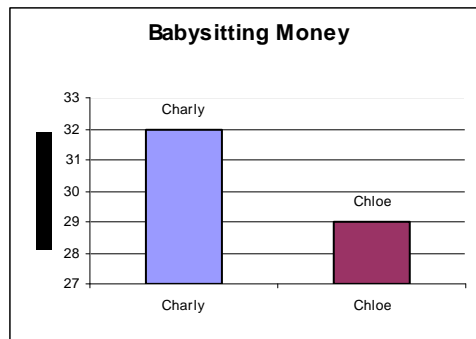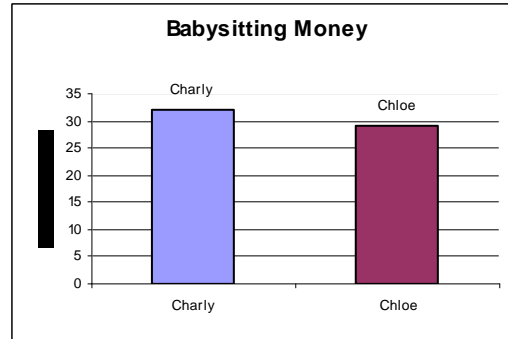
| Babysitting Money	Babysitting Money
Charly: 32, Chloe: 29 (scale 27–33)	Charly: ~32, Chloe: ~29 (scale 0–35)

- What is the same about both graphs?

- What is different about the graphs?

- Which graph gives the appearance that Charley made a lot more money than Chloe? Why?

- Which graph is misleading?

Name:_____ **(Answer Key)**
Guided Notes – "Misleading Graphs"
Objective: Communicate the use and misuse of statistics

- Why do people use graphs to display data?

    Answers will vary depending on students' responses

- What are some of the reasons/ways a graph can be misleading?

    - **Break in the graph**
    - **Not starting the axis at zero**
    - **Inconsistent scale on one or both axis**

Look at graphs A and B about Charley and Chloe's babysitting earnings.
Answers to this section will vary depending on students' responses
- What is the same about both graphs?

- What is different about the graphs?

- Which graph gives the appearance that Charley made a lot more money than Chloe? Why?

- Which graph is misleading?

Comparing Graphs

Graph A

Babysitting Money

Graph B

Babysitting Money
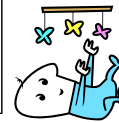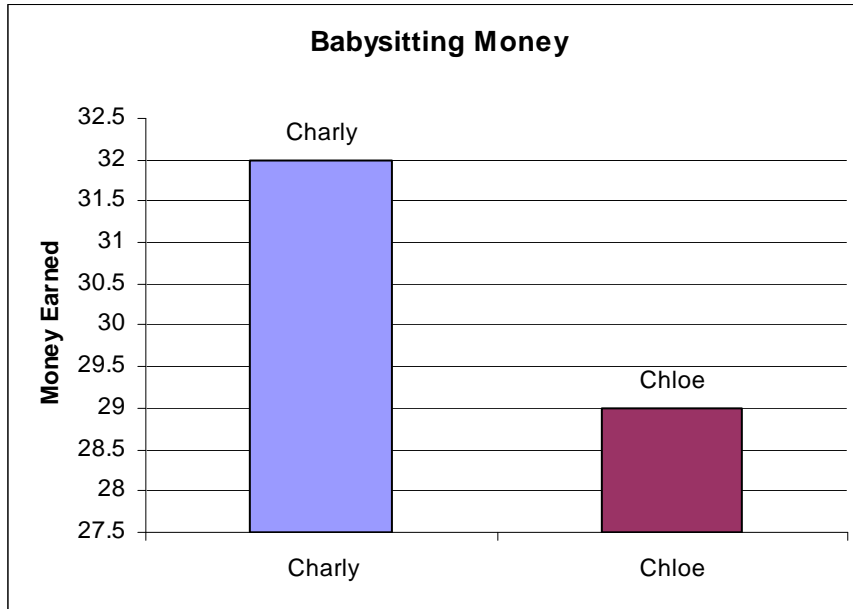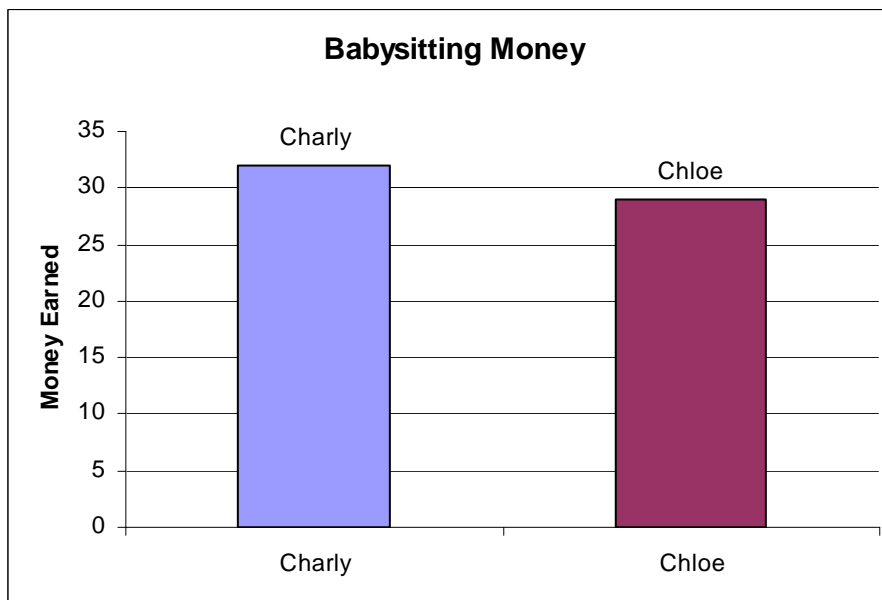
Newspaper Activity

Take a newspaper and look for graphs. Find at least 3 graphs. Cut the graphs from the newspaper and paste into your guided notes. Complete the questions for each graph. Once you have completed the assignment turn in your guided notes.

Graph 1

- What information is the graph trying display?

- Does the graph have any characteristics of a misleading graph? Describe what you see.

- Would you consider the graph misleading?

Graph 2

- What information is the graph trying display?

- Does the graph have any characteristics of a misleading graph? Describe what you see.

- Would you consider the graph misleading?

Graph 3

- What information is the graph trying display?

- Does the graph have any characteristics of a misleading graph? Describe what you see.

- Would you consider the graph misleading?

Misleading Statistics Test

1. The graph displays data about a country's pecan production. Determine why the graph is misleading.

Pecan Production
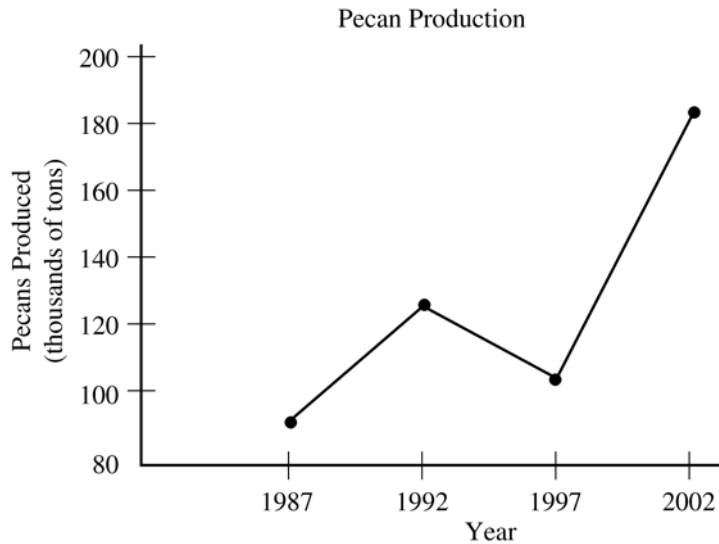
[A] The labels are missing.

[B] The distance between the units is not uniform.

[C] The axis does not include a zero.

[D] The graph is not misleading.

2. The stem-and-leaf plot below shows the scores for a midterm exam. Which of the following could not be used to describe a measure of central tendency of the scores?

Scores

Stem	Leaves
9	1 2 7
8	2 6 6 9
7	2 2 2 3 8
6	1 3 3 4
5	1

[A] 78   [B] 73   [C] 72   [D] 76

3. Use the following chart to describe the average reader. Which description of the average reader is not true?

| Reader	Kevin	Jade	Juan	Bernice
Type of Book	Mystery	Novel	Novel	Horror
Number of Pages (week)	125	257	59	143
Grade Point Average	3.1	2.3	3.3	3.7

[A] reads novels

[B] has a grade point average of 3.1

[C] reads 146 pages a week

[D] reads mystery stories

4. The graph displays data for Jamway Jelly Products. In what way is the graph misleading?

January Jelly Sales
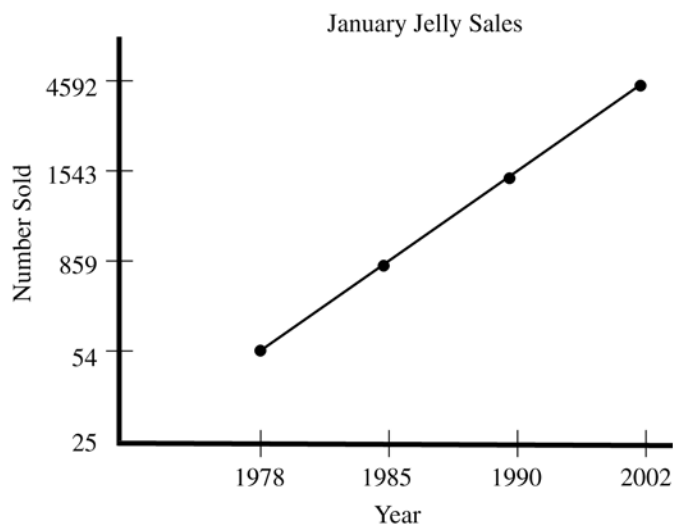
[A] The vertical axis does not include zero.

[B] The units on the x-axis are not uniform.

[C] The units on the y-axis are not uniform.

[D] All of these reasons.

5. The graph displays data for technology use in public schools. In which way is the graph misleading?

Technology in Public Schools
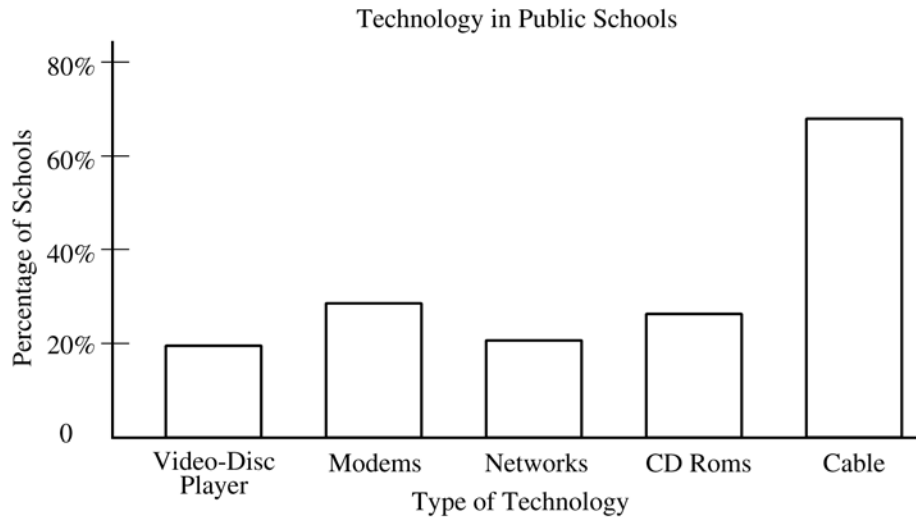
[A] The vertical axis does not include zero.

[B] The scales are not labeled.

[C] The distance between units is not uniform.

[D] The graph is not misleading.

6. The graph displays data about the number of kilowatt hours used. Determine if this graph is misleading. Explain your answer.

Number of Kilowatt Hours Used
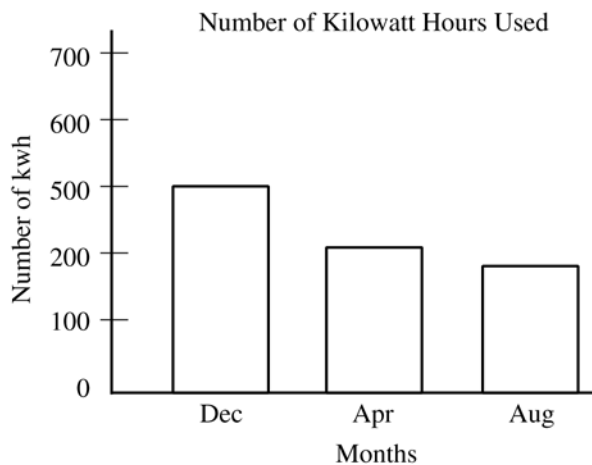
7. The graph displays data about the number of homes sold in Humboldt County. Is the graph misleading? Explain.

Number of Homes Sold in Humboldt County
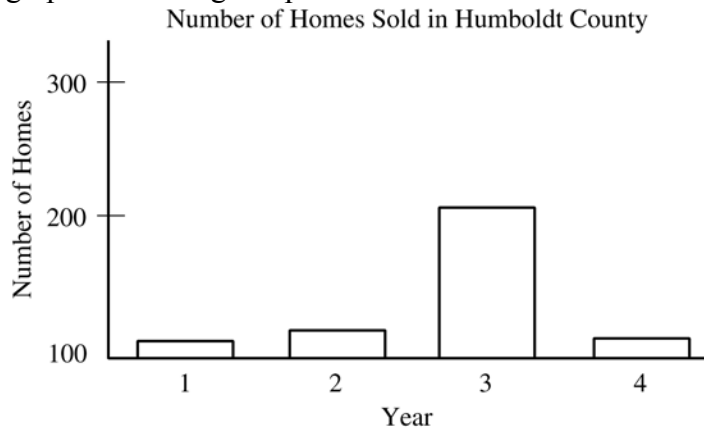
8. The graph displays data about a company's net worth. Is the graph misleading? Explain.

Company's Net Worth
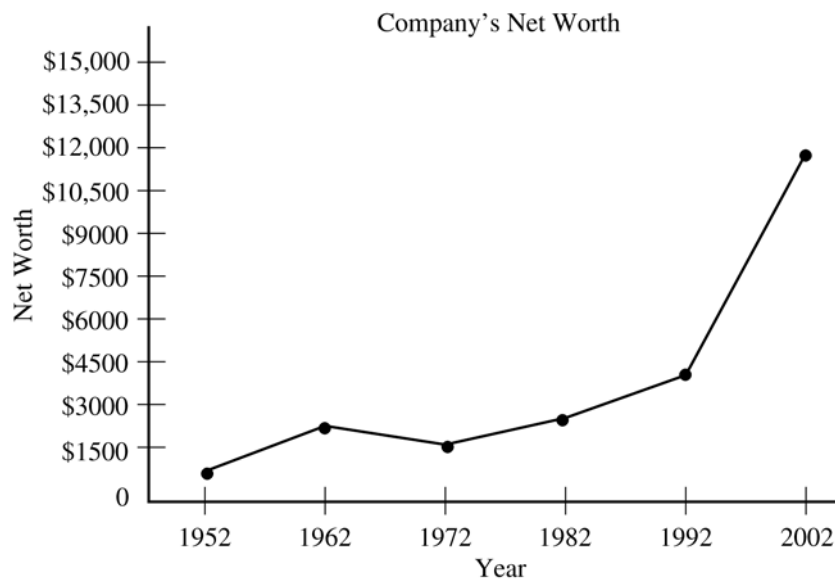
9. The graph displays information about one company's percent of the pet food market. Is the graph misleading? Explain.

Percent of Pet Food Market
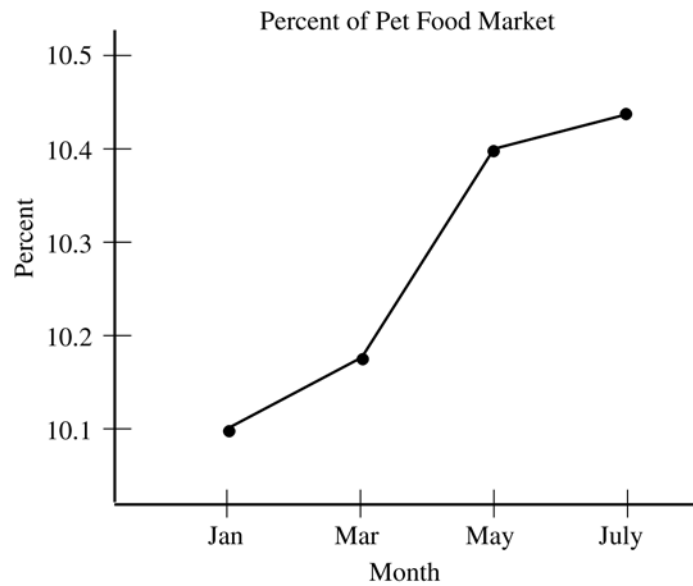
Answer Key to Misleading Statistics Tests

[1] [C]

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[2] [A]

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[3] [D]

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[4] [D]

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[5] [D]

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[6] The graph is misleading. The units are not uniformly marked.

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[7] The graph is misleading. There is no zero on the vertical axis.

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[8] No, the graph is not misleading.

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[9] The graph is misleading. The vertical scale has no zero. There appears to be a dramatic rise in the percent of the market share. It is actually only an increase of 0.2%.